DOCUMENT RESUME

ED 417 988 SE 061 337

AUTHOR Chin, Chi-Chin; Tuan, Hsiao-lin
TITLE The Development of STS Modules--Taiwanese Teachers' Beliefs and Their Work in Utilizing the Resources of Science Museum.
PUB DATE 1998-04-19
NOTE 24p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (71st, San Diego, CA, April 19-22, 1998).
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Action Research; *Educational Resources; Educational Strategies; Elementary Secondary Education; Foreign Countries; *Knowledge Base for Teaching; *Museums; Relevance (Education); *Science and Society; Science Education; *Science Teachers; *Teacher Attitudes; Theory Practice Relationship
IDENTIFIERS Taiwan

ABSTRACT

The purpose of this study was to investigate the growth of teachers' beliefs through being involved in the process of developing science, technology, and society modules based on the educational resources of a science museum in Taiwan. Action research was the source of data from two elementary and two secondary science teachers who participated in the module-developing work. Findings indicate that teachers' work is influenced by their prior knowledge of the science, technology and society curriculum; their beliefs in teaching; and the educational environment in Taiwanese society. Teachers persist in their original beliefs and the ways in which they utilize museum resources. The need for the development of inservice programs emphasizing both content and strategies in utilizing the resources is also indicated. These programs could assist teachers in developing the ability to connect with the informal settings. Contains 18 references. (Author/DDR)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 417 988

The Development of STS Modules— Taiwanese Teachers' Beliefs and their Work in Utilizing the Resources of Science Museum.

Chi-Chin Chin
Teacher Education Program,
Tunghai University, Taiwan, R.O.C.

Hsiao-lin Tuan
Graduate Institute of Science Education,
Changhua Univesity of Education, Taiwan,R.O.C.

C Chin

2B

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Paper presented in the Annual Meeting and Conference
for the National Association of Research in Science Teaching,
April 18-22, San Diego CA, USA
1998

BEST COPY AVAILABLE

801337

The Development of STS Modules--Taiwanese Teachers' Beliefs and their Work in Utilizing the Resources of Science Museum.

Chi-Chin Chin
Teacher Education Program,
Tunghai University, Taiwan, R.O.C.

Hsiao-lin Tuan
Graduate Institute of Science Education,
Changhua Univesity of Education, Taiwan,R.O.C.

Abstract

The purpose of this study was to investigate the growth of teachers' beliefs through involving a process in developing the STS modules based on the educational resources of science museum in Taiwan. Action research was used in the whole process to collect data from two elementary and two secondary science teachers who participated in the module-developing work. Findings showed that teachers' work was influenced by their prior knowledge about the STS, their beliefs in teaching, and the educational environment in Taiwanese society. Teachers' recognition on the informal learning was inadequate. However, they persisted in their original beliefs and the ways in utilizing the museum resources. It is recommended that science museum should develop the in-service programs emphasizing both content and strategies in utilization of the resources as the basis for the teachers to develop their ability to connect with the informal settings.

Key words: STS，Teacher education，Teacher belief，Museum education。

Objectives of the Study

In the recent years, the establishment of the co-operative connection between formal educational system and informal settings such as science museums, mass media and community-based programs have been

BEST COPY AVAILABLE

regarded as one of the effective routes to enhance the science education(ASTC Newsletter,1994; Crane, Nicholson, Chen, & Bitgood, 1994). Since the environment of the science museum, for instance, is labeled as user-friendly and less-structured compared with the school, informal learning settings could be one of the vital vehicles to motivate learners to touch the scientific concepts on one hand, and on the other hand, to help them foster the positive attitudes toward the science-related issues(Bitgood,1988 ; Finson & Enochs,1987). For k-12 school science teachers, science museums and science centers especially play the roles as "the resource centers" in the school district or the community due to their abundance with the collections and exhibits which are potentially organized for the further educational purposes(Drake, 1992). Informal learning settings have become one of the most attractive elements while teachers develop their educational activities for enhancing students learning in recent years(Igoe,1993). According to Tamir's study(1983), the effectiveness of kids' learning in science was facilitated if teachers used field trips to the places like science museums, botanical gardens, zoos, or planetarium, etc. after the science lessons in the school. Based on such empirical evidence, the status of informal settings in enhancing the science education has earned more attentions than before. Science educators become to agree that the teacher should act as the vital role in teaching science by utilizing the resources from the informal settings. Their efforts would also determine how successful the co-operative relationship of schools and informal settings help kids learn science (Chin,1995a; Hodgson,1986; Szpakowski,1973). Oslund, Gennaro, & Dobbert (1985) and Galbraith(1990) also suggested that if the teacher could organize the visit systematically, instead of the traditional way that randomly selecting the viewing objects, learning effectiveness of students would be facilitated significantly. Through making the connection with the science museum, teachers could not only empower themselves in employing such kinds of resources(Finkelstein, Stearn, & Hatcher, 1985; Bedworth, 1985; Paine,1989), but also get acquainted with social status of the informal settings (Forber,1993), which is the most feasible and effective way for our citizens to nurture their habits and ability for continuing education as early as possible for preparing the future days

not in the school anymore. Only if the teacher is empowered with more adequate background such as the resources of the science museum and the strategies in using these resources, could the instruction in the science museum become more well-framed and purpose-oriented.

Since the importance of the utilization of museum resources in the school teaching has been emphasized in the recent decades, science educators began to investigate the factors influencing teacher empowermet in terms of the museum education. However, if compared with western countries, the study of museum education in Taiwan is staying at the quite different stage and focus. The major reason is because the newly founded museums with various emphases such as National Museum of Natural Science(NMNS), National Museum of Science and Technology (NMST), and National Museum of Marine Life(NMML) have been planned since early 80's and then will be all finished and opened to the public shortly before the end of this century, the history for the concept of museum education spread in Taiwan is not too long enough for both general public to understand the nature and the rationale for their life, and museum curators to develop comprehensive baseline data for the both scholar and practical purposes. However, although the limit number of the studies were reported till now, the results provided the information that even though teachers strongly desired to get familiar with the museum resources and to know how to utilize these resources in the effective ways (Huang,1992; Liu,1989), teacher's perception of the museum education was inadequate.(Chin,1995a). The fact that few Taiwanese teachers have realized the comprehensive functions of the museum also makes teachers could not catch the spirit of the learning in the informal settings(Chin,1995b). Most of the teachers emphasized the objectives of learning in the cognitive domain when they visited the science museum with children. Because of short of the understanding in the nature of museum education, Taiwanese teachers usually over-emphasized the importance of the acquisition of scientific concepts in the science museum. Science teachers usually defined their guidance to the kids in the science museum as the extension of the science lessons in the school. Therefore, they percepted the major purpose for the visitation was to enhance kids to learn scientific concepts. The objectives of learning on the else domains were so easily ignored. Such

BEST COPY AVAILABLE

a purpose and rationale for utilizing the educational resources of the science museum held by the teacher were also likely to lead a consequence that learners' perceptions about the functions of the science museum played for science education have been narrowed down to a technical level. And the learning happened in the science museum was looked as the subordiate to the schooling system. The endeavors made from the informal settings were aslo seen as the part of fulfiling the educational goals of the school. It is believed that no special topics providing materials relevance to informal settings in both the in-service and pre-service teachers programs was the main cause for such a consequence. If the statement that a future citizen should get acquainted with the possible channels for learning how to continue his/her learning after leaving the school is true, we might argue that teachers ought not to omit the opportunities for kids to touch the topics related to informal settings. However, the premise for our future citizen to obtain such equippments is that teachers themselves should be empowered first in this area for acting effectively as the mediators to help students expand their perceptions beyond the traditional definition and the scope of the learning in Taiwanese society. Under such a circumstance, an in-depth study designed for inquiring the current status of teachers by using action research methods is needed not only for the short-term purpose for establishing the data basis in detail, but also go further for constructing a suitable teachers program infused with the ingredients from the realm of museum education.

Therefore, the purpose of this study was to investigate the growth of teachers' beliefs through involving a process in developing the STS modules based on the educational resources of science museum in Taiwan. Since the science museum is abundant with real samples and specimens for meaningful learning, it is worthwhile to investigate teachers' beliefs and their capability in infusing such resources in the development of STS modules. In the other words, the stuy was based on the following three conditions: 1) The developed products should be according to the educational materials from the science museum, 2) Such products should be appropriately for teachers used in the informal environment with their students, and 3) The developed modules should meet with the requirements that adopting societal issues and by means of the

technological issues as the vehicles to help learners understand the scientific concepts. The main objectives for the whole development process included:1)teachers' beliefs about the STS teaching before and after the process, 2)teachers' perceptions about the educational resources in the science museum for application in the development of STS modules before and after the process, and 3)the factors played in affecting the transition of teachers' beliefs and application in science teaching. In short words, this study was mainly based on a module-developing process filled with teachers' active involvement for researcher to undergo an action research for investigating teachers' dynamic growth and the factors as facilitators or inhibitors for their growth.

The findings of this study will be not only used for understand the teachers themselves but also adopted as the basis for science museum to develop suitable in-service programs to empower teachers' professional ability needed for the realm in the informal education.

Research Design and Procedures

Action research was used in the whole process to develop STS modules based on the resources from the science museum. In the participating group of four teachers(two secondary and two elementary teachers), an elementary(Long) and a secondary(Mei) science teachers were focued for collect in-depth data which were then used for comparing and inducing their beliefs and actions in terms of the developing the STS modules based on the informal science settings. All four participating teachers were purposively selected with at least a period of experience as the volunteers in the science museum for meeting the minimal requirements that they had the basic recognition and experience in the museum environmnet. These prior knowelge and experience hopefully provided them the basis for the development of the modules. The personal information of two focused participators is listed as below:

Long--male, 55 years old, a graduate of teachers junior college, continued to obtain the advanced degree from the in-service teacher education program, and now not only teaching science cource at fifth grade in a city elementary school, but also

BEST COPY AVAILABLE

serving as the coordinator for academic affairs for the school ; with more than 30-year teaching experience ; usually organize the visits to the natural field with his students, colleagues, and students' parents ; emphasizes the importance of real experience providing for the students, with the experience in developing the self-guided worksheets mainly for young kids to use while visiting the science museum ; the schedules for the visit of his students to the science museum were frequently organized by himself.

Mei--female, a graduate of the normal university, biology major, with master degree in science education, teaches biology course in the secondary school for 14 years, with the same work experience in the science museum as Long, also serves as the connecting channel for the museum and the school she is teaching in.

In the whole process for action research, records from discussions, teachers' designs for the prototype modules, the following revised versions, interviews with teachers, the practicing teaching based on their designs, and the feedback from the students and the peers in the group were used as data sources for the study. The study group met together on the weekly basis. Three researchers from the science museum and the university also attended the regular meetings. The role played by them was as the participators.

In the first phase of the study, the concept of the STS and the exemplar STS modules were shown and discussed for setting the basic blocks for the further activities. And then, group members proposed potential topics for peers sharing the ideas based on the possibility for societal and technological issues infused, the major scientific concepts conveyed, the suitability for the specific grade levels, and the extent of the connection with educational resources in the science museum. The interesting topics such as energy, evolution, time, and water etc. were suggested in the goup meetings, and after that each member was requested to do his/her independent study in collecting the relevant resouces. After the inquiring period, a series of the discussion periods were held for comparing the feasibility and the

significance between the proposed topic in the development of STS modules. Thereafter, the consensus was achieved to adopt the concept of water as the main area for the teachers to develop their modules in the second phase for 1)its significance in maintaining human life, 2)there being abundant resources around developers, 3)many topics taught in the different grade levels through various courses, and 4)several relavant exhibits and activities already existing in the science museum.

After more in-depth discussions, the guidelines for group members to develop the prototype modules were determined as follows:

Four developers would work under a global title—

Cherish the Water Resources in the World,

and each member develop his/her own module named as

1)the importance of water resources,

2)water cycle on earth,

3)water contamination, and

4)water purification, respectively to act as the baisc blocks to construct the structure coping with the main title. In the developing stage, the educational resources of science museum were strongly recommended to be used as basic blocks infused into the STS modules. Mei decided to focus the importance of water resources, and Long's work followed the issue of water contamination.

The second phase lasted for 2 months. During the period, the proto-modules were submmitted to the group meeting session in the form of paper. Peers examined the format for each other first, and then listened to the oral presentations by the developer. In the meanwhile, group members also provided their comments from their own positions that acted as the stimulators for the further revisions. Through the interaction between peers, each module was revised in this phase.

Thereafter, each teacher underwent a session of practice in the real situation of the science museum as the third phase. All practicing sessions were recorded by video, and in the final phase the recorded materials were shown in the meetings for fascilitating the reflection. The modules were then asked to be revised as possible.

There were a series of structured questions used in the interviews with teachers on the individual basis. The schedule for the interviews was:1)before they entered the study, 2)after the exemplar STS modules

BEST COPY AVAILABLE

were presented, 3)after they designed the prototype modules, 4)after they fulfilled their practices in the science museum, and 5)after the group meeting periods for the reflection based on their video-records.

The data from the various sources were checked according to the triangulation. In addition, the group discussions between three researchers participating the whole process played roles in achieving the consensus on the findings as conclusions.

Findings

1.The influence of prior Experience in Education(Being Taught and Teaching)

The extent of the perception on the STS was different between Mei and Long. Because the prior major in Biology at the college level and the further in-service training in the graduate school on the field of science education, Mei was more acquainted with the theories and the strategies proposed by science educators in the recent years than Long. For instance, because Mei had learned "the jargons" such as constructivism, and STS during her study years in the graduate school, she could shared a general difinition of STS like the following statements with the participatants in the first group meeting of the project.

> STS is a kind of strategy utilized in the science teaching. Science teacher could adopt a certain of societal issue which might be related with students' daily experience to make the science concepts more easily understood by learners.

On the contrary, Long did not have any idea about the STS. He said:

> I have never heard STS before. However, I would like to listen to my fellows' opinions. Their replies about the definition may help me understand it.

It is clear that Long did not have the prior background on such issue. From the in-depth interview, he told the researcher what the purpose for him to attend the project:

> I like to learn the novice things. That's why I am so active to participate the in-service workshops. This is the first time for me to attend such a long project. By cooperating with the curators in the science museum and other fellows, I hope to learn some new ideas and strategies which are hopefully benefit for improving my science teaching.

For Mei, the different view about the discussion content in the group meetings. Because she had knowledge background on the STS issues, Mei complained that the discussion sessions did not meet what she needed. She said:

> The most of the STS topic we discussed were what I already knew before. I appreciate the way discussion leader taking care of the meeting. Actually, there were some strategies I can learn for leading the dicussion. However, I was not enlighted on the else fields. Especially there was no new idea provided from other participants. I don't think their previous background were enough in the field of science.

It is quite interesting that Mei, the same as Long, eagered to learn more about what she did not experience before; however, although she emphasized the researcher demonstrated the examplar way for leading the discussion, she did not regarded such as what she had learned something so-called "enlightment" for her. Mei still cared about learning the novice things on the areas of content. For instance, she thought the things needed to be covered in the discussion for her were new sociental issues related to the science and /or environment she had never heard or thought before. As a Biology graduate, Mei looked the examples like *the impact of the establishment of dam on the humaing being*, *the comtamination of the water by human activities*, and *the Biotechniques used for improving the human welfare* were too easy. In short words, Mei and Long defined the novice things in the different ways.

Judging from the motivation for attending the project, Mei and Long showed the different stories. Long did not held the sound prior background. But he thought the everything forwarded in the project could

BEST COPY AVAILABLE

be new block for him to establish the conceptual framework in the science teaching. Through engaing the tasks in the process, Long also found the way he had done in teaching science before was cope with the rationale on the STS. He felt happy about such experience in "feeling" the theories through the practices. He shared his feelings with the fellows like that:

> I make the connection between the theory and the practice for the first time in my life. I become to understand what the science educators said about the STS and the way to develop the STS modules. Through such a process, I also got the chance to reflect what and how I taught for elementary science course. The view provided by fellows gave me the foundation I could follow to revise my teaching.

Apparently, compared with Mei's focus on the knowledge basis, what Long concerned was more holistic. The content and the strtegies learned from the project were appreciated by him. As a experieced science teacher with teaching experience more than 30 years, Long did not received a specific field of scientific discipline. While Long joined the program for preparing the elementary teachers 3 decades ago, the program was filled with compulsory comprehensive courses. No elected field was possiblly chosen as one's special. In other words, elementary pre-service teachers at that time were trained for meeting the purpose of covering the most of areas taught in the elementary school. Therefore, Long, as a member of them, did not have the professional training such as what we call "the major". Before he become a regular science teacher, Long had the experience in teaching social studies, health education, Chinese language and literature, etc. Although he lacked of the professional training to be a science teacher, however, the interest for obtaining the update information and attending the in-service workshops for the science were regarded as the most important factors for him to keep abreast of the current trends in terms of the science teaching.

Although Mei had the relatively more professional background both in the biology and science education areas, such prior educational experience also made her tendency to inquire the science content rather than the teaching strategies and/or the ways to representing the

concepts. However, Mei's misexplanation for the relationship between the scopes of the *ecology* and the *environmental science* influenced the issues adopted in the developed modoule. In other words, not benificial from her broader background, Mei was insteadly constrained from the information without well distinguished.

For instance, while discussing if the environmental issues were suitable to be used in the STS-oriented teaching, Mei's confusion about the difference between STS and STS-E was evoked. According to her explanation, when environmental issue was used, it should reflect to science for introducing the ecological concepts and the problems on the area of environmental science were not allowed to be presented. Once in the discussion session she mentioned：

> The first "S" is the abbreviation for the word "science". Therefore the work in the development of STS moldule is based on the issues occuring in the society to introduce scientific concepts to kids. ...In the field of science, the ecological concepts are strongly associated with the environment. I have ever heard the term "STS-E" before. In my view, the "E" here represents the environmental issues in the society. We should make the difference the environmental issues from societal issue. If the environmental issues is used, the purpose is to help kids understand the ecological concepts in the area of biology.... It is not used to explain the environmental problems themselves. It should go to the basic ecological level.

However, while her later work was checked, it was found that such prior knowledge really made her confused about the commonality and the difference between STS and STSE. The module developed by Mei obviously revealed that the element of E (environmental issues) was avoid for coping with the request of the STS modules. In her view, environmental concepts were quite different from the ecological concepts, which were regarded as the inclusion of the scientific concepts. In other words, her definition about the STS and STS-E limited the approachable issues she might choose, and her moldule appeared concept-learning dominated.

BEST COPY AVAILABLE

Compared with Mei, Long did not have any background in the definition of the STS education before he attended the work. In the interview, Long expressed:

> I have never heard this term(STS) before. I really have no idea about how to design a module coping with the spirit of STS. I guessed STS teaching must be filled with the interactions between teacher and students and students themselves. After the developing process you requested, I think I would be more familiar with such kind of teaching strategy.

Interestingly, Long eagered to get acquainted with what STS was and beared with a thought that it must be a teaching strategy different from the traditional way to teach. On the contray, Mei, as a secondary teacher, concernd more about the feasibility of STS strategy in her regular science classroom. Besides the reason of the busy schedule, she also illustrated the following statements according to her understading about the differences between junior high students:

> There is discrepancy between theory and practice. I don't think it is feasible in my science classroom. It is no doubt that "A" students will learn something independent of the way to teach. On the contrary, even STS strategies were used in the teaching, "C" students still have no motivation to learn.

Apparently, the prior teaching experience obtaining from the different levels led teachers to hold the different beliefs about the feasibility and the willingness to utilizing STS teaching. The fact that the learning environment and the educational goals formed in the Taiwanese society in the last few decades was not so easy to change even though educators have put lots of efforts to do the reforms. As a secondary science teacher under such a circumstance, Mei regarded that even it was not likely to use the developed STS modules in the real science classroom, less it should that the modules were developed on the basis of the resources outside the school environment. Therefore, she treated the developing work as the tast-oriented one. The previous teaching experience detered them to consider the way in

infusing into the existing educational system, at least try to adjust the way of the teaching in some of her own science classes as the pilot studies. On the other hand, the educational goals set at the elementary level was not direct for the entrance examination for the next level of the stuy; therefore, Long appeared the more willingness to touch the new ideas and try the new strategies in the practical teaching environment.

2.Vague definition on the role of technology

·Both teachers did not realize the actual role of the T(technological issues) in the STS modules. In their works, none of the technological issues was used systematically. In the discussion period, the researcher illustrated a certain of typical technological issues such as invented equipments (ie.,refriegirator, TV, water purificator), artificial construction(ie., reservior, nuclear power plant, and water power plant), and biotechniques(ie., biology control, pregnant test, kidny dialysis, and test-tube babies) and explained the scientific principles or theories used for developing such technological creatures or methods before teachers started to develop the modules. Although the relationship between the science and technology was described explicitly and teachers said they understood it, when engaging in the real work, both of them expressed the adoption of the technological issues into the STS modules was not easy. Even after the comments and reflections from peers and themselves, the revised versions showed little change. Before the developing task, Long said :

> I understand the device of technology need science. But I don't realize the role of the technology here in STS module, and how and why technology is used in the science teaching if it should be as one of the elements in the whole activity. Actually, I did not cover too much material directly related to the technology in my regular science class. I mainly focus on scientific concepts to teach my students. While teaching science, I have ever illustrated examples related to technology. But I just mentioned it

BEST COPY AVAILABLE

> superficially. I did not collect more detail information to create an activity. If I retrospect my science teaching, I think I used societal issues more comfortable than technological issues.

In oder to clarify the relationship of S-, T-, and S-, researcher collected a certain of literatures and assigned them to read. And then, the researcher also provided more detail explanation. After that, the researcher interviewed teachers about their perceptions of the relationship between technology and each of science and society. Besides that, their later work was also checked again. It is found that the status of the technology was still vague in the developed modules. Long expressed his feelings and mentioned the real problem she faced concerning the usage of the technology as follows :

> I don't really understand the meaning and the scope of the technology. That's why I could not choose suitable technological issues infused into the STS module.

When expliciting the relationship between each two elements among S,T,S, Mei mentioned the role of technology in the STS teaching as the part direct to connect with the human needs; however, she did emphasize "science" as irrelavance to human daily activities. Mei said:

> Because the purpose of technology is to meet the human desires, there is no doubt to elicit the societal issues. But science does not impact on the society directly.

In Mei's definition, technology is the mediator for science to influence the society. But she was fail to explain how science provides the basic ideas for technology.

General speaking, the adoption of technological issues into science lessons is difficult for Taiwanese science teachers. Although information was provided for enforcing their understanding, the developed STS modules were still lack of logical and systematical connection in terms of the technology to the science and society parts. One of the possible reasons is that science teachers did not

touch enough information related to technology while they registered in the pre-service programs as those who majored in engineering. Under such a circumstance, their understanding of the relationship between baisc science, pratical science and technology is also vague.

3.Teacher's sensitivity to the current societal issues

The societal issues chosen for infused into the STS modules were not so motivated for the students. The level of sensitivity to the societal issues held by the teachers should be elevated for the improvement of the quality of the STS modules. Mei even said:

> Because of the busy schedule, I even have no spare time to read the newspaper, watch TV news....Even if the time is allowed, I don't want to know such nonsense stuffs. I don't think it is really connected with my real life.

However, when asked her attitudes toward the recycle policy and pig-fever issues just occured in Taiwan, she became more passionate and began to share her ideas with the colleagues. In the discussion, Mei replied:

> These issues were not covered in the textbooks. Even if I would like spend some time in the class, the first idea coming to my mind is that I don't have the enough time to finish the materials covered in the textbooks.

The traditional perceptions and habits in the science teaching made her hold the view that the utilization of the societal issues was the additional educational materials and not indispensable for the science teaching. On the contrary, Long infused a lot of societal issues into his regular science class. According to his statement, the infused materials came from the following resources: newspaper, magazines, books, scientific show in the television, and science films in the vedio tapes made for the public. In his class, some of the material were transformed into the overhead parafilm for the purpose of presenting to the kids easily. Kids could followed his topics easily and the time for the arranging the material was also

BEST COPY AVAILABLE

economical. If Mei's and Long's science teaching were compared, it is concluded that the educational goals of the different level of studies led them to show the quite different beliefs in the ways to teach science course. The beliefs they held then affected their action in the class. In terms of the societal issues, Mei become more alient. She even said:

It does not play the vital role in my daily life.

Nonetheless, she might present another image of the teaching if the teaching in the junior high level was not just for the high school entrance examination. Compare to Long who could act as the master for the science class, Mei, as a junior high biology teacher, could be described as a person who was inhibited to train a group of the kids to become the master of the paper-pecil test takers.

4.Teacher's preference of teaching strategies

The preference of teaching strategies also played the role in affecting their development of STS modules. For instance, Long has the teaching experience in the elementary school more than 30 years. According to researcher's personal interaction with him for more than two years, Long held a strong belief that field trips should be adopted to the regular science class as he can as possible. No wonder that he also used field trip to the Ta-Chai River for observing the contamination of the water in the developed module even though the requirement of the policy for developing the modules was set as that the developer ought to utilize the resources from the science museum. However, because the field study to the 30 miles away made schedule busy and less flexible, he reduced the time for utilizing the resources of science museum to merely one hour.The STS modules developed revealed more field-work oriented rather than the museum oriented.

Mei was likely to view science in the positivist way. She adopted an experiment in the module for kids to practice basic scientific process skills. However, the experiment took a long time and, to the

similar consequence, the module was infused with few resources from the science museum.

5.The atmosphere of learning environment

The teachers regarded the learning environment with the variety of teaching strtegies was automatically cope with the requirements for the STS teaching. However, although discussions, class interactions, presentations, and pupils' works etc. were used in the practicing teaching by teachers, it was regretful that none of them acted as a facilitator and integrator in the class. Compared with their regular teaching in the school, they used more teaching methods and collected more teaching materials from various channels. For instance, the instructional strategies used by Mei included: 1)observation, data collection, and compare the difference through the experimental process, 2)small-group discussion, 3)teacher-led whole-class discussion, 4)teacher-guiding veiwing the exhibit hall and interpretation, and 5)student working on the workseets, but her skills in organizing the variety of methods and materials were incompetent in this case. Most of the time, Mei still played traditional role in focusing on transmitting something to the kids. For example, although she would like make kids to follow the discussion guidline in the whole-class discussion session, while facing the condition that the participating students short of discussion ability and could not grasp a mainstream discussion trend in the class, Mei did not play the role as the facilitator to help students construct the atmosphere for the continuing discussion through the process of forming the core issues. Isteadly, Mei's strategy was to assign group representatives to present his or her ideas. Most of these content in the oral presentation were not related to each other. The ability of summarization and integration of students was not adequate. However, Mei did not act as a vital role while encountering such kinds of the responses from the kid.

6.Too much content coverage

The developed STS modules were filled with too much content. The teaching process was not well-structured, either. Even the feedback

BEST COPY AVAILABLE

was obtained from the final phase, teachers merely made some minor revisions. In general, they strongly sticked to the structure that they have already developed. They expressed what they included in the modules was so abundant that kids could learn something from their practices. Mei deleted one unit from her modules mainly because of the time constraint. Long changed the time for kids to read the assignments from the day for field trip to the previous days for the reasons that to save the time on one hand, and provide enough time for kids to digest the manual of the activity. The period for Mei's and Long's modules were 3 plus 1/2 and one whole day, respectively. After they executed the module for the first experience, they unominously replied:

> The time is too short. I cannot finish my practice within the period I have expected.

In the reflection period after the practice, it is interesting that none of teachers commented that his or her colleagues have covered too much content. All of them were inclined to more concern the pace they proceeded. Instead of deleting unnecessary elements and making the modules more focus on in-depth issues, they tried to keep what was developed as possible. According to the interview, Mei showed her care about the content kids could obtain from her module. Obviously, the natue of informal settings such as active, liberal and cogenial were not felt as major concerns by them.

7.Less relavance to the museum resource

If the developed modules were examined, it is found that the extent of utilization of museum resources was quite low. Beside that, the ways for connecting the issues to the educational resources from the science museum were not so logical. Because the participating teachers were all experienced as volunteers in the museum, and their knowledge about the resources of the science museum was more than average teachers. However, the knowledge in how to use such resources was lacked. They even said:

> We are not so familiar with the educational resources in the science museum. I suggest if we could make a

overview in the exhibit hall before we developed the modules, the effectiveness of work might be improved.

Although teachers committed their knowlege in the resources was inadequate, they did not think they lacked the knowledge background on the strategies to utilize the museum resources. Based on the finding that even the teachers with museum experience was not eligible to use the museum resources, and the ability to transfer the strategies was constrained from their little knowledge about informal learning context, it is recommended that the opportunities of the in-service programs emphasizing both content and strategies in utilizing the museum resources should be developed and privided from the perspective of the museum educators.

8.Teacher's perceptions of the rationale for the work

Through the whole process, Mei regarded the development of STS modules as task-oriented rather than the opportunities for the empowerment. The question usually asked was:

> Is my work meet with the requirement of the standard of the science museum?

She once complaint that the work in the informal setting was quite different from what they did in the school, and were inclined to use the framework constructed inside the schooling system to make the judgement. On the other case, Long faced the work as the opportunity to learn what he had never experienced. His response showed that he did not just satisfy with fulfilling the obligation for the science museum. Long said:

> I like to learn more. What I learn can be enrich my science teaching.

Long's motivation for attending the module-developing group was different from Mei's. What he concerned was not that the high quality module could be developed through the developing process. He never asked "Is my work meet the standards?" Insteadly, he looked the work as his benefits. However, both Mei and Long easiy to accept what they have done. Even though the peers gave them the suggestions, they only

BEST COPY AVAILABLE

made the minor revisions for the modules. Although they were supposed to work on the basis of the museum context in the developing process, however because another set of value system fitting for the formal education still dominated their work, what the participators automatically became as the disturbing factor while interacting with the museum educators for developing the modules.

Besides that, some beliefs were still remained firmly. For instance, Mei indicated:

> It was not necessary to utilize the resources in the science museum to develop the STS modules for the topic we had chosen.

Even though the purpose of the developing work based on the informal settings was communicated and announced frequently along the process of development, Mei positions still stayed on the side of formal education. Mei revealed the reluctance in using the resources in informal setting and continued complaining on the requirement for the resources infusion. The teachers understood the importance of the purpose for the study, but always suspected the effectiveness of the modules based on the informal settings.

In conclusion, Taiwanese teachers' perceptions about the utilizing resources of informal setting is not adequate; the level of their practicing ability remain a low level, too. Along with a 9-month study, the framework held by teachers have changed little. In author's view, the atmosphere and the traditional emphasis of the educational system in Taiwan have played the major effect on such a consequence. Although informal educational institutes have been established over the island during the past decade, school and family did not really understand the role of the informal settings. The visit is still for traditional purposes. The number of teachers with correct cognition about the museum education in Taiwan is not high. Under such a brand-new situation for the Taiwanese society, science museum should devote more energies in making the connection to the formal education. As the curators, we can not expect teachers and students will recognize us by themselves!

Bibliography

1.ASTC Newsletter.(1994). Informal science education efforts on rise, but their impact remains unclear, study suggest. ASTC Newsletter, 22(3), 1,3.Bedworth,J.(1985). Science Teacher Education at Museums: A Resources Guide. Washington, D.C.:ASTC.

2.Bitgood,S.(1988). A comparison of formal and informal learning. Technical Report No. 88-10, Jacksonville, AL : Center for Social Design.

3.Chin,C.C.(1995a). Teachers' perceptions of the goals of teaching in the science museum and their strategies. Proceeding of 1st Conference on Science and Mathematics Teacher Education, 394-423. Changhua, Taiwan:NCUE.

4.Chin,C.C.(1995b). The development of teachers:in-service EE program in the science museum. NSC84-2511-S178-001. Taipei, Taiwan: NSC.

5.Crane.V., Nicholson, H., Chen, H., & Bitgood. S.(1994). Informal science learning: what research says about television, science museum, and community-based projects. USA:Research Communications Ltd.

6.Drake,C.S. (1992). Museums in the community--an education resource museum. UNESCO, 44(2), 96-99.

7.Finkelstein,J.,Stearn,S., and Hatcher,B.(1985). Museum are not just for observing anymore! Social Education,Feb.,1985,150-154.

8.Finson, K.D. and Enochs, L.G. (1987). Student attitudes toward science-technology-society resulting from visitation to a science-technology museum. Journal of Research in Science Teaching, 24, 7, 593-609.

9.Forber,D.(1993). The management of the museum as a teaching resources. Learning Resources Journal,9(2),32-34.

10.Galbraith,M.W.(1990). The nature of community and adult education. In Galbraith,M.W.(ed.) Education through community organization. San Francisco:Jossey-Bass. Pp89-92.

11.Hodgson, J.F. (1986). Teaching teachers museums team up with schools and universities. Museum News, 1986, Jun, 29-35.

12.Huang,C.C.(1992). The study of the strategis to make the collaborative relationaship of schools and NMNS. Taichung, Taiwan:NMNS.

13. Igoe,K.(1993). Advancing the educational role of museums. ICOM News,1(2),8.
14. Liu,T.S(1989). The study of science teachers as volunmteers for the National of Natural Science. Taichung, Taiwan:NMNS. Studies in Science Education,10,1-36.
15. Lucas,A.(1983). Scientific literacy and informal learning.
16. Ostlund,K.,Gennaro,E., & Dobbert,M.(1985). A naturalistic study of children and their parents in family learning courses in science. Curator,22(8),723-741.
17. Paine,S.(1989). Museum as resources in the education and training of teachers. In E. Hooper-Greenhill(ed) Initiatives in Museum Education. U.K.: Dept. of Museum Studies, University of Leicester.
18. Szpakowski, A.(1973) Collaboration between Museum and School. in Museums, Imagination and Education. published by UNESCO.

BEST COPY AVAILABLE